F–2947

Sub. Code
7MPHE3A

M.Sc. DEGREE EXAMINATION, APRIL 2021 &
SUPPLEMENTARY / IMPROVEMENT / ARREAR EXAMINATIONS
Fourth Semester

Physics

Elective — NANOSCIENCE

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What are elements? Mention the fundamental subatomic particles.

2. Draw the characteristic table of nuclear radiation.

3. What are nanomaterials?

4. List out the nanomaterials preparation methods.

5. Define Fullerene, C_{60}.

6. Mention the types of nanotubes.

7. Outline in short the nanoscale motors.

8. Define radiation.

9. What will nanoelectronics do for us?

10. Define semiconductors.

Part B $(5 \times 5 = 25)$

Answer **all** the questions choosing either (a) or (b).

(Draw the diagram wherever it is necessary in need)

All questions carry equal marks.

11. (a) Explain the concept of Energy.

Or

(b) Write a short note on molecules and phases.

12. (a) Explain the working of Chemical vapour deposition.

Or

(b) Discuss about the mechanism of electro-deposition.

13. (a) Outline the laser method to prepare carbon nanotube.

Or

(b) Describe the working of Ball milling technique.

14. (a) Give a brief account on nano holes and photons.

Or

(b) Discuss about the photonic crystals, surface wave guides, and control of light paths.

15. (a) Explain about the invention of Transistor.

Or

(b) Discuss the working of High electron mobility transistors.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Discuss the followings: (a) molecular and atomic size, (b) surfaces and dimensionality phases, and (c) atomic structure.

17. Discuss in detail about the plasma arcing and ball milling techniques.

18. Outline briefly the properties and uses of carbon nanotubes.

19. Mention the properties of light and nanotechnology. Explain the concept of imaging technique.

20. Describe the concept of Quantum interface transistor and single electron transistor.

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F–4665	Sub. Code
	7MPHE3B

M.Sc DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Fourth Semester

Physics

Elective: ANALYTICAL INSTRUMENTATION

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. State Lambert's-Beer law.

2. List the different types of optical filters used in absorption spectrometry.

3. Explain about the classification of IR region of spectrum.

4. Give four different techniques used for sampling of solid in IR spectrometry.

5. What are Stokes and anti-Stokes lines in Raman spectroscopy?

6. List the various detectors used in X-ray fluorescence spectrometer.

7. Mention the limitations of NMR.

8. What are the advantages of electron spin resonance spectroscopy?

9. Discuss any two applications of flame emission spectrometry.

10. List the light sources used in atomic absorption spectrometry.

Part B $(5 \times 5 = 25)$

Answer **all** questions choosing either (a) or (b).

11. (a) Explain about the monochromators and detector used in UV-visible absorption spectrometer.

Or

(b) The molar absorptivity of a compound in aqueous solution at 765 nm is 1.54×10^3. The percentage of transmittance of a solution in a cell with a 1 cm path length is 43.2. Find the concentration of the solution.

12. (a) Explain the working principle of various detectors in IR spectrometer.

Or

(b) Explain the different radiation sources in IR spectrometry.

13. (a) Describe the principle and instrumentation of X-ray fluorescence spectrometer with neat schematic.

Or

(b) Explain in detail about the laser sources and detectors used in Laser Raman spectrometer.

14. (a) In NMR spectroscopy, mention the advantages of using a magnet with as great a field strength as possible. Also explain the difference between a continuous wave and FT-NMR.

Or

(b) Explain the instrumentation and applications of scanning electron microscope.

15. (a) Explain flame emission photo spectrometry with its instrumentation.

Or

(b) Distinguish between atomic absorption and flame emission spectroscopy.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Explain with a block diagram the operation of a double beam UV-Visible spectrophotometer. Mention its advantages over a single beam instrument.

17. What are non-dispersive spectrometers? Explain in detail the FTIR spectrometer. What are the advantages of the same?

18. Explain the phenomenon of Raman and Rayleigh scattering. With neat block diagram explain laser based Raman spectrometer.

19. Describe the principle, instrumentation and working of electron spectroscopy with neat diagram.

20. Draw and explain the arrangement of the major part, and working principle of atomic absorption spectrometer.

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F–4666

Sub. Code
7MPHE4A

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Fourth Semester

Physics

Elective: THERMODYNAMICS AND STATISTICAL PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Explain the concept of internal energy.
2. State the principle of increase of entropy.
3. What is the effect of temperature and pressure on mean free path?
4. State any two assumptions of kinetic theory of gases.
5. Define the term thermodynamic probability.
6. What do you mean by statistical equilibrium?
7. What statistics would you use for the following:
   (a) α -particles,
   (b) protons,
   (c) liquid He^4 and
   (d) phonons.

8. Mention any two physical processes that classical statistics fails to explain.

9. Explain why specific heat of metals at low temperatures can be expressed as $C_v = \lambda T + \beta T^3$, where λ and β are constants.

10. What do you mean by fluctutation?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Define various thermodynamic potentials stating the conditions under which each is specifically useful.

Or

(b) Interpret each term of the equation $dQ = dU + dW$ and enunciate the law connected to it.

12. (a) Derive Maxwell's distribution law of velocities.

Or

(b) Give Einstein's theory of Brownian movement.

13. (a) Derive an expression for the partition function for a system of '*n*' free particles moving inside a cubical box of length *L*.

Or

(b) Give an account of Gibb's canonical ensemble.

14. (a) Deduce Bose-Einstein distribution law.

Or

(b) List out the basic assumptions on which the classical Fermi - Dirac and Bose - Einstein statistics are developed. Mention the conditions for the validity of the respective distribution functions.

15. (a) Discuss Einstein's model of specific heat of solids.

Or

(b) Deduce an expression for Fermi energy ε_F. Calculate the value of zero point pressure in terms of Fermi energy.

Part C $(3 \times 10 = 30)$

Answer any **three** questions.

16. Derive Maxwell's thermodynamic relations between pressure, volume, temperature and entropy of a homogeneous system.

17. Derive Boltzmann transport equation and discuss its validity.

18. Derive an expression for the entropy of a perfect gas using microcanonical ensemble.

19. What do you understand by Bose-Einstein condensation? Calculate the critical temperature at which the condensation will start.

20. Give a brief account of one dimensional Ising model. Show that one dimensional model cannot explain the ferromagnetic behaviour of a metal. Discuss the reason for it.

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F–4667

Sub. Code
7MPHE4B

M.Sc DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Fourth Semester

Physics

Elective: COMMUNICATION ELECTRONICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define modulation index for FM wave.
2. What factors determine antenna gain?
3. Define pulse width modulation.
4. What do mean by shift keying?
5. What are microwaves? Why are they called centimeter waves?
6. Define Doppler frequency in MTI radar.
7. What is Numerical Aperture?
8. What are Splices?
9. What are low earth orbiting satellites?
10. Mention the various multiple access scheme used in cellular communication.

Part B (5 × 5 = 25)

Answer **all** questions choosing either (a) or (b).

11. (a) Explain the theory of amplitude modulation.

Or

(b) Write short note on Half Wave Dipole.

12. (a) Explain pulse code modulation technique.

Or

(b) Write note on frequency division multiplexing.

13. (a) How reflex klystron is used as a microwave oscillator? Explain.

Or

(b) Derive Radar range equation.

14. (a) Distinguish between step index and graded index fibre.

Or

(b) Calculate numerical aperture, acceptance angle and the critical angle of a fiber having core refractive index equal to 1.5 and the cladding refractive index equal to 1.45.

15. (a) Explain various types of satellite orbits.

Or

(b) What is CDMA? Explain.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Describe the theory of Hertzian dipole.

17. Explain the following:

    (a) ASK

    (b) FSK

    (c) PSK

18. Describe the construction and working of Magnetron.

19. Explain fibre optical communication system with neat block diagram.

20. Explain the architecture of GSM.

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F–4668

Sub. Code
7MPHE5A

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Fourth Semester

Physics

Elective – ENERGY AND ENVIRONMENTAL PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Write any two causes of greenhouse effect.
2. List the elements of weather and climate.
3. What is solar radiation?
4. Define collector efficiency.
5. What is meant by digester?
6. Mention any four factors that affect biodigestion.
7. Write any two advantages and disadvantages of fuel cell.
8. Point out the safety and management of hydrogen.
9. Define plumes.
10. What are the major sources of noise pollution?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either, (a) or (b).

11. (a) State and explain Raynold's transport theorem

Or

(b) Write a note on hydrostatic equilibrium.

12. (a) Elaborate the solar radiation on tilted surface.

Or

(b) How will you describe the performance of solar collector using energy balance equation?

13. (a) Give a brief a note on the process of photosynthesis.

Or

(b) Tabulate the advantages and disadvantages of dome and drum type biogas plant.

14. (a) How is hydrogen used for electricity generation?

Or

(b) Write a short note on hydride batteries.

15. (a) What are the factors that governs air and water pollution? Explain.

Or

(b) Compare land and sea breeze.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Elucidate the following:

    (a) Variation of temperature, pressure and density with height and

    (b) Composition of air.

17. With necessary diagram, elaborate the flat-plate solar collector and mention its advantages.

18. Give a detailed explanation on continuous and batch type biogas plant with neat sketch.

19. Enumerate the different types of fuel cells.

20. Discuss the purification and control devices of water and air pollution.

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F–4669

Sub. Code
7MPHE5B

M.Sc DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Fourth Semester

Physics

Elective: MEDICAL PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is meant by lung volume?
2. What is an electrocardiogram?
3. Indicate some of the causes for hearing loss.
4. Write the difference between sound and ultra sound.
5. What is meant by laser?
6. What is meant by chromatic aberration?
7. What is the purpose of X-ray radiography?
8. Mention the various units of radiation and radioactivity.
9. Write the important function of the blood.
10. What is meant by heart sound?

Part B (5 × 5 = 25)

Answer **all** questions.

11. (a) Discuss the magnetic signals from the heart.

Or

(b) Discuss the physics of some common lung diseases.

12. (a) Discuss the production of speech.

Or

(b) Describe the working of hearing aid.

13. (a) Discuss about retina and its function.

Or

(b) Discuss the various parts of light microscope and its application in medicine.

14. (a) Discuss about fluoroscopy and the production of live x-ray images.

Or

(b) Discuss about brachytherapy and the different radioactive sources used in this mode of treatment.

15. (a) Discuss the major components of cardiovascular system.

Or

(b) Discuss the function of pacemakers.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Discuss the physics of lungs and breathing.

17. Discuss the function of outer ear, middle ear and inner ear.

18. Discuss the applications of ultraviolet, infrared and laser in medicine.

19. Explain the principle of radiation therapy and discuss the role of fractionation in the treatment of cancer.

20. Discuss about cardiovascular instrumentation.

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F–4991	Sub. Code
	7MPH1C1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement/ Arrear Examinations

First Semester

Physics

MATHEMATICAL PHYSICS – I

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Evaluate the triple integral $\int_{y=-2}^{3}\int_{z=1}^{2}\int_{x=y+z}^{2y+z} y\,dxdzdy$.

2. The work done by a force in moving a particle of mass m from any point (x, y) to a neighbouring point $(x+dx, y+dy)$ is given by $dw = 2xydx + x^2dy$. Calculate the work done for a complete cycle around a unit circle.

3. Find the general solution of the differential equation $(y + xy^2)dx - xdy = 0$.

4. The trace of a 2 × 2 matrix is 4 and its determinant is 8. If one of the eigenvalues is $2(1+i)$ determine the other eigenvalue.

5. Show that the complex function $f(z) = 2x^2 + y + i(y^2 - x)$ is not analytic at any point.

6. Determine the zero and order of the function $f(z) = (z + 2 - i)$.

7. What are the essential conditions to be satisfied for a function to be expanded in a Fourier series?

8. What are Dirichlet's conditions for a Fourier series expansion?

9. State the shifting property of Fourier transform.

10. Define the term integral transform.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Verify Green's theorem in the plane for $\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$, where C is the boundary of the region defined by $y = \sqrt{x}$ and $y = x^2$.

Or

(b) Evaluate $\iint_S \vec{r} \cdot \hat{n}\, d\hat{S}$, where S is the surface of the upper hemisphere of radius a with centre at (0, 0, 0) and $\vec{r}$ is the position vector.

12. (a) State and prove Cayley-Hamilton theorem.

Or

(b) Solve the following system of equations

$x - y + 2z = 3,\ x + 2y + 3z = 5,\ 3x - 4y - 5z = -13$

13. (a) Evaluate $\oint_C \frac{dz}{z^2+1}$, where C is the circle $|z| = 4$,

Or

(b) Expand the function $f(z) = \frac{1}{z}$ centered at $z_0 = 1$. Give the radius of convergence of the series.

14. (a) Find the Fourier integral of the function $f(x) = e^{-kx}$, when $x > 0$ and $f(-x) = f(x), k > 0$.

Or

(b) Expand as a Fourier series the function $f(x) = x^2$ in the interval $-\pi < x < \pi$ and show that $\pi^2 = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots$

15. (a) State and prove Convolution theorem.

Or

(b) Find the Fourier cosine transform of the function $f(x) = \sin nx$.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Construct an orthonormal basis of $(-1,-3,3,1)(1,1,-1,0),(3,-5,2,1)$ and $(-1,1,0,1)$.

17. Find eigenvalues and eigenvectors of the matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & -1 & 1 \\ 3 & 1 & 1 \end{pmatrix}$.

18. Evaluate $\int_0^{2\pi} \frac{d\theta}{(2+\cos\theta)^2}$ using Cauchy's residue theorem.

19. Obtain a cosine series expansion of the function $f(x) = (1+x)$ valid in the interval $0 \le x \le 2$ and hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots = \frac{\pi^2}{8}$.

20. Use the method of Fourier transform to determine the displacement $y(x,t)$ of an infinite string, given that the strings is initially at rest and the initial displacement is $f(x), -\infty < x < \infty$. Show that the solution can also be put in the form

$$y(x,t) = \frac{1}{2}[f(x+vt) + f(x-vt)].$$

F–4992	Sub. Code
	7MPH1C2

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement/ Arrear Examinations

First Semester

Physics

CLASSICAL DYNAMICS AND RELATIVITY

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What are generalized coordinates?

2. Give one example each for holonomic and non-holonomic constraint.

3. Calculate the reduced mass of H_2 molecule. Assume the mass of H atom to be equal to M.

4. What are first integrals?

5. What are body and space coordinates systems in relation to the motion of a rigid body?

6. What are coupled oscillators?

7. Point out any two advantages of constructing canonical transformation for a given Hamiltonian system.

8. Write Hamilton's equations of motion in terms of Poisson brackets.

9. State the fundamental postulates of special theory of relativity.

10. An electron and a positron practically at rest come together and annihilate each other. Calculate the energy released.

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) Prove the law of conservation of linear momentum for a system of interacting particles.

Or

(b) Set up Euler-Lagrange's equation of motion of one dimensional linear harmonic oscillator. Integrate the obtained differential equation and draw the solution plot (x, t) of it.

12. (a) Show that the problem of two bodies moving under the influence of a mutual central force is equivalent to a one-body problem moving about a fixed force centre.

Or

(b) A particles describes a conic $r = \frac{p}{1+ \in \cos\theta}$

where p and $\in$ involve constant quantities. Show that force under which particle is moving is central.

13. (a) What are moments of inertia and products of inertia?

Or

(b) What do you understand by stable and unstable equilibria?

14. (a) Derive Hamilton's equation of motion from a variational principle.

Or

(b) For what values of m and n do the transformation equations $Q = q^m \cos np,\ P = q^m \sin np$ form a canonical transformation. Obtain the generating function.

15. (a) What is mass-energy equivalence? Obtain the relation $E = mc^2$.

Or

(b) Obtain the transformations for the components of the momentum-energy four vector.

Part C $(3 \times 10 = 30)$

Answer any **three** questions.

16. Derive Lagrange's equation of motion from D'Alemberts's principle.

17. Discuss the motion of a particle under a central attractive force inversely proportional to the square of the distance from the centre of force. Find the conditions under which the orbit will be an ellipse, parabola or hyperbola.

18. Discuss the vibrations of a linear triatomic molecule.

19. Outline the Hamilton-Jacobi theory and apply it to solve the problem of one-dimensional harmonic oscillator.

20. Write Maxwell's equations in terms of scalar and vector potentials. Show that these equations are invariant under gauge transformations.

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F–4993	Sub. Code
	7MPH1C3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement / Arrear Examinations

First Semester

Physics

QUANTUM MECHANICS – I

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is the minimum uncertainty in momentum of an electron confined in a space of linear dimension $1\,^{\circ}A$ (h = 6.67×10^{-34} joule-see)?

2. For any three operators $\hat{A}, \hat{B}, \hat{C}$ prove that $\left[\hat{A}.\hat{B}\hat{C}\right] = \left[\hat{A}.\hat{B}\right]\hat{C} + \hat{B}\left[\hat{A}.\hat{C}\right]$.

3. Do you expect simultaneous eigen functions of the Hamiltonian and momentum operators of a free particle? Explain.

4. What is the zero point energy of a one-dimensional linear harmonic oscillator? Why is the zero-point energy is never zero?

5. What do you understand by 'spin-up' and 'spin-down' states? What are spinors?

6. For a spin-$\frac{1}{2}$ system, state the matrices for S_x, S_y and S_z.

7. The result of the variation method always gives an upper limit for the ground state energy of the system. Why?

8. What do you understand by a classical turning point? How could one get the turning points if the potential is known?

9. What are singlet and triplet states?

10. Illustrate exchange degeneracy with an example.

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) Outline the postulates of quantum mechanics.

Or

(b) Explain Schrödinger picture. Obtain the time derivative of expectation value of an observable in it.

12. (a) Write down Schrödinger's wave equation for a particle in a box. Solve it to obtain eigen functions and show that the eigenvalues are discrete.

Or

(b) A particle of mass m is confined to move in a potential $V(x) = 0$ for $0 \le x \le a$ and $V(x) = \infty$ otherwise. The wave function of the particle at time $t = 0$ is given by $\psi(x,0) = A \sin\frac{5\pi x}{a} \cos\frac{2\pi x}{a}$. Normalize $\psi(x,0)$.

13. (a) Obtain the commutation relation for $\hat{L}_x, \hat{L}_y$ and $\hat{L}_z$, where L_x, L_y, L_z are the components of angular momentum operator. Show that $\hat{L}^2$ commutes with every one the three components.

Or

(b) Derive matrices for the operators J^2, J_z, J_x and J_y for $j = \frac{3}{2}$.

14. (a) Evaluate the energy values of normal state of hydrogen using variation method.

Or

(b) Solve the problem of linear harmonic oscillator by WKB method and compare the results with those obtained by classical method.

15. (a) What is Slater determinant? How does it incorporate Pauli principle?

Or

(b) How did Hartee obtain the central field in his theory of many electron atom?

Part C $(3 \times 10 = 30)$

Answer any **three** questions.

16. Deduce the equation of motion in the momentum representation.

17. Set up Schrödinger equation for a rigid rotator. Find its eigenvalues and eigenfunctions.

18. Determine all the Clebsch-Gordon coefficients for addition of angular momenta $\frac{1}{2}$ and $\frac{1}{2}$.

19. Use Schrödinger perturbation theory for non-degenerate levels and apply it to explain first order Stark effect in hydrogen.

20. Find an expression for the electron density in Thomas-Fermi model and show that the radius of the sphere enclosing a fixed fraction of all electrons is proportional to $z^{\frac{-1}{3}}$.

F–4994

Sub. Code
7MPHE1B

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

First Semester

Physics

Elective – CRYSTAL GROWTH PROCESSES AND CHARACTERIZATION

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define the term nucleation.
2. What is absolute and relative supersaturation?
3. Discuss the advantages of gel method.
4. Explain the principle of chemical reduction method of gel growth.
5. What is wetting angle in melt growth process?
6. Explain necking process in Czochralski growth.
7. Explain about linearly time varying temperature profile in CVT growth.
8. Write the principle of hydrothermal growth.
9. Discuss the various applications of etching study.
10. What is the role of interferometer in FTIR spectrometer?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Describe the slow evaporation and slow cooling methods for single crystal growth.

Or

(b) Discuss the different characteristics of good solvent. Explain Meir's solubility diagram.

12. (a) Explain the principle of gel method and discuss the different types of gels.

Or

(b) Describe the single and double diffusion gel methods with suitable diagrams.

13. (a) Describe the principle and experimental arrangement of Bridgman method.

Or

(b) Explain in detail the various advantages and disadvantages of Czochralski method.

14. (a) Explain the principle, experimental arrangement and growth procedure of PVD technique.

Or

(b) Briefly explain about the different kinds of autoclaves and their functions for hydrothermal growth.

15. (a) Describe single crystal X-ray diffraction technique for crystal structure analysis with neat diagram.

Or

(b) Give a brief note on Vicker's microhardness tester for mechanical strength analysis.

Part C ($3 \times 10 = 30$)

Answer any **three** questions.

16. Describe the following with neat diagrams

(a) Constant Temperature Bath (5)

(b) Crystallizer (3)

(c) Seed preparation and mounting (2)

17. (a) Discuss the various importance of gel methods. (6)

(b) Describe the complex and decomplexion, and solubility reduction methods. (4)

18. Write an essay on Czochralski method of crystal growth with suitable diagrams.

19. (a) Describe chemical vapour deposition method with suitable examples. (5)

(b) Give a brief account on electrocrystallization. (5)

20. State Beer- Lambert's law. Explain the principle, instrumentation and working of UV-visible spectrophotometer. Discuss the applications of UV-visible spectroscopy.

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F–4995	Sub. Code
	7MPH2C2

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement/ Arrear Examinations

Second Semester

Physics

MATHEMATICAL PHYSICS – II

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. State the first shifting theorem of Laplace transform.

2. Show that $L\{e^{at}\} = \frac{1}{s-a}$, if $s > a$.

3. Classify the given partial differential equation $u_{tt} - u_{xx} + u = 0$ by a way (a) order, (b) degree, (c) linearity and (d) homogeneity/non-homogeneity.

4. Write down three dimensional wave equation.

5. What are the possible values of Epsilon tensor?

6. What is the number of independent components of (a) a symmetric tensor, (b) a skew symmetric tensor of rank 2, in *n*-dimensional space?

7. What are various symmetry elements?

8. Define Abelian group.

9. Find the value of $\beta(1, 2)$.

10. Determine the expression $\frac{2}{3}P_2(x)+\frac{1}{3}P_0(x)$.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Find $L^{-1}\left\{\frac{1}{(s-1)^5(s-2)}\right\}$.

Or

(b) Find the Laplace transform of $H(t)$ defined as

$$H(t)=\begin{cases} t+1 & 0 \le t \le 2 \\ 3 & t > 2 \end{cases}$$

Also determine $L\{H'(t)\}$.

12. (a) Using separation of variables method obtain the solution of the partial differential equation $u_t = u_{xx} + y_{yy}$.

Or

(b) Construct the solution $u(x,t)$ of the partial differential equation $u_t = 3u_{xx}$ for $t > 0$ and $0 < x < 2$ subject to the boundary condition $u(0,t) = 0, u(2,t) = 0$.

13. (a) Show that the inner product of tensors A_r^{pq} and B_t^S is a tensor of rank 3.

Or

(b) Show that any contravariant or covariant tensor of second rank can be expressed as the sum of a symmetric and an antisymmetric tensor of the same rank.

14. (a) Give an example of a group which has a subgroup and construct a multiplication table for its elements.

Or

(b) Define a cyclic group and show that a group of order four may or may not be a cyclic group.

15. (a) Show that $x J_n^1(x) = n J_n(x) - x J_{n+1}^{(x)}$.

Or

(b) Prove that $\int_{-1}^{1} x^2 P_{n+1} P_{n-1} dx = \frac{2n(n+1)}{(2n-1)(2n+1)(2n+3)}$.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Using Laplace transform method obtain the solution of the differential equation $\frac{d^2y}{dx^2} + 9y = 40e^x$ subject to the condition $y(0) = 5, y'(0) = -2$.

17. Express the three dimensional Laplace equation in cylindrical coordinates.

18. Define a metric tensor. Determine it in the case of spherical coordinates.

19. State and prove Schur's lemmas for the irreducible representation of a group.

20. Show that $\int_0^\infty e^{-x} L_n(x) L_m(x) dx = \delta_{m,n}$, where L_n and L_m are Laguerre polynomials.

F–4996	Sub. Code
	7MPH2C3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement/ Arrear Examinations

Second Semester

Physics

ELECTROMAGNETIC THEORY

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Prove that $\nabla \times E = 0$.
2. Does the potential $V = ex^2 - 2y^2 + 2z$ satisfies Laplace's equation?
3. "Magnetic force do not work". Justify
4. Define magnetic susceptibility and permeability.
5. List out the Maxwell's equation for linear isotropic media.
6. Point out the condition for Coulomb gauge.
7. Define skin depth.
8. What is a wave guide?
9. Compare normal and anomalous dispersion.
10. Recall Rayleigh scattering.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Deduce Coulomb's law from Gauss's law.

Or

(b) Obtain an expression for electrostatic energy of a charge distribution.

12. (a) State and explain Biot-Savart law.

Or

(b) Compare electrostatics and magnetostatics.

13. (a) By describing the importance of displacement current, list out Maxwell's equations.

Or

(b) Establish the law of conservation of energy of electrodynamics.

14. (a) Write a note on plane electromagnetic waves in free space.

Or

(b) Elaborate the TE mode of rectangular waveguide.

15. (a) Elaborate the significance of Jefimenko's equations.

Or

(b) Comment on Thomson scattering by a free electron.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Based on multipole expansion, prove that the potential due to charge distribution is the sum of monopole, dipole, qudrapole and higher moment.

17. Obtain the expression for magnetic vector potential.

18. By mentioning the paradox of Newton's III law in electrodynamics, show that

$$\frac{\delta}{\delta t}\left(\rightarrow_{P\,mech} + \rightarrow_{P\,field}\right) = \nabla \cdot \underset{T}{\leftrightarrow} .$$

19. What is Fresnel's formula? Arrive at Fresnel's equation for nonconducting media when electric field vector E is perpendicular to the plane of incidence.

20. Derive Lorentz dispersion equation for gases.

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F–4997	Sub. Code
	7MPH2C4

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement/ Arrear Examinations

Second Semester

Physics

QUANTUM MECHANICS – II

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. What is the aim of a time-dependent perturbation theory?

2. What is known as sudden approximation? Give an example of a perturbation that can be treated as an adiabatic.

3. Write two applications of scattering experiments.

4. Define scattering amplitude and scattering cross-section.

5. State the meaning of stimulated absorption.

6. Define density matrix.

7. Write the Klein-Gordon equation for a relativistic particle in a potential V.

8. Mention two properties of Dirac matrices.

9. Give two reasons for necessity of quantum field theory.

10. What do the terms first quantization and second quantization represent?

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) List any three differences between the effects of constant and harmonic perturbations.

Or

(b) Illustrate the theory of sudden approximation with an example.

12. (a) In a scattering process the wave function is

$$\Psi = \exp(ikz) + [(\cos\theta)/10]\,[\exp(ikr)]/r$$

Calculate the total scattering cross-section.

Or

(b) Obtain the scattering amplitude for Yukawa potential applying Born approximation.

13. (a) For a two-level atom set up the density matrix.

Or

(b) Establish the relations between Einstein coefficients.

14. (a) For the Dirac free particle set up the continuity equation.

Or

(b) Show that for a Dirac particle orbital angular momentum is not conserved but the sum of orbital angular momentum and spin angular momentum is conserved.

15. (a) If the Lagrangian density of a system is

$$L = (1/2)(\partial q/\partial t)^2 - (1/2)(\partial q/\partial X)^2$$

Then find the wave equation using the Euler-Lagrange equation.

Or

(b) Set up the Lagrangian and Hamiltonian densities for nonrelativistic Schrödinger equation and then show that they lead to Schrödinger equation.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Derive an expression for transition rate per unit time for a system subjected to the perturbation $W(x)\exp(-i\omega t)$ during the time interval 0 to T.

17. Describe the calculation of scattering amplitude by partial wave analysis.

18. Discuss the interaction of incident radiation with an atom.

19. Construct the plane wave solution of Dirac equation for a free particle.

20. For an electromagnetic field in a vacuum obtain classical field equations and convert them into quantum field equations.

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F–4998	Sub. Code
	7MPH3C1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

ATOMIC AND MOLECULAR PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all the** questions.

1. How is spin-orbit interaction defined?

2. State Hund's rule.

3. What is meant by Born-Oppenheimer Approximation?

4. Classify the modes of resonators.

5. Write the effect of isotopic substitution in rotation spectra.

6. Differentiate microwave and IR spectroscopy.

7. State Raman Effect.

8. Define dissociation energy.

9. Recall the causes of chemical Shift in NMR spectroscopy.

10. What is free radicals?

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) Give a comparative note on LS and JJ coupling schemes.

Or

(b) Describe the spectrum of Alkali atom.

12. (a) Sketch out bonding and anti-bonding of MOs.

Or

(b) Find the relation between Einstein's A and B coefficients.

13. (a) Figure and explain the rotational spectra diatomic molecules.

Or

(b) Write on the symmetric top molecule in IR spectroscopy.

14. (a) Elucidate the rotational and vibrational shifts of diatomic molecule.

Or

(b) Illustrate Franck-Condon Principle.

15. (a) Explain the Bloch equations in NMR Spectroscopy..

Or

(b) Draw the block diagram of ESR spectrometer and explain its working principle.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Elucidate the various quantum states of electron in atom.

17. With necessary diagram, describe the experimental arrangement and theory of normal Zeeman Effect.

18. Derive an expression for energy of rotational states of a non-rigid rotator.

19. Discuss about the rotational fine structure of electronic vibration transitions in detail.

20. Give a detailed note on the experimental arrangement of double coil method in NMR spectroscopy.

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F–4999	Sub. Code
	7MPH3C2

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

NUCLEAR AND PARTICLE PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What do you know about spin and parity?

2. Mention any two properties of nuclear forces.

3. Give the non-conservation of parity in beta decay.

4. Write the principle of semiconductor detector.

5. List the characteristics of nuclear fission.

6. Outline solar fusion.

7. How is the angular momentum conserved?

8. Classify the types of nuclear reaction.

9. Order the list of interactions that exist in nature according to their strength.

10. What is Hyperons?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) How the shell model of a nucleus accounts for the existence of magic numbers.

Or

(b) Give the properties of ground state of deuteron.

12. (a) Derive the expression for Geiger and Nuttal law.

Or

(b) Sketch out the modes of operation in a scintillation counter.

13. (a) With neat diagram, explain the working of cyclotron.

Or

(b) Write a note on controlled thermonuclear reactions.

14. (a) Find the expression for Q equation using nuclear reaction kinematics.

Or

(b) Describe the compound nucleus model with its energy level.

15. (a) Explain Gellmann Nishijima formula.

Or

(b) Illustrate time reversal and CPT theorem.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Elucidate low energy n-p scattering.

17. Give the basic principles of particle detectors and sketch out ionization chamber.

18. Using liquid drop model, explain Bohr-Wheelers theory of nuclear fission in detail.

19. Derive the equation for Breit-wigner dispersion formula for resonance scattering.

20. Illustrate the various types of interactions in elementary particles.

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F–5000

Sub. Code
7MPH3C3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement / Arrear Examinations

Third Semester

Physics

ADVANCED ELECTRONICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is semiconductor?

2. What is a varactor diode?

3. Draw the circuit symbol and pin configuration of the 741 chip Operational Amplifier.

4. Write any two characteristics of ideal Operational Amplifier.

5. Define D flip-flop.

6. Compare static and dynamic RAM.

7. What do you mean by oscillator?

8. Sketch the internal architecture of 555 timer.

9. Find the modulation index and percentage of modulation if modulation voltage is 7.5 V and the carrier wave voltage is 9 V.

10. What is the required band width for amplitude modulation?

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) Illustrate the working of LED with its schematic symbol.

Or

(b) Describe the forward and reverse bias characteristics of PN junction diode with neat diagram.

12. (a) Define all parameters of the Operational Amplifier.

Or

(b) Explain how a comparator acts as (i) a square wave generator and (ii) a zero crossing detector.

13. (a) Explain the functioning of SR flip flop using NAND latch.

Or

(b) Briefly explain the followings

(i) ROM,

(ii) PROM,

(iii) EPROM

(iv) EEPROMS.

14. (a) With a neat circuit diagram, briefly explain the working of phase shift oscillator,

Or

(b) Discuss the working of Schmitt trigger using 555 times.

15. (a) Distinguish between PWM and PPM.

Or

(b) State the principle of tunnel diode and describe its behaviour.

Part C $(3 \times 10 = 30)$

Answer any **three** questions.

16. Expound the input and output characteristics of a transistor in common emitter configuration along with circuit diagram.

17. Give an experimental set up to solve the following simultaneous equations,

$$x + 2y = 3;\ 2x - y = 1$$

18. Explain the functioning of shift right configuration using JK flip flop.

19. Exemplify dual slop analog to digital converter with necessary diagram.

20. Describe the operation, transit time and modes of reflex klystron oscillator with the aid of suitable schematic diagram.

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7MPH2C1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &
SUPPLEMENTARY / IMPROVEMENT / ARREAR EXAMINATIONS

Second Semester

Physics

SOLID STATE PHYSICS
(CBCS – 2017 onwards)

Time: 3 Hours

Maximum: 75 Marks

Part A

Answer all the questions. (10 x 2 = 20)

1. What types of diffraction patterns are obtained by crystalline and amorphous solid?

2. Explain screw dislocation.

3. What is plastic deformation?

4. Substantiate the statement, 'a monoatomic linear lattice acts as a low-pass filter'.

5. Explain the term drift velocity.

6. Define the term effective mass of an electron.

7. What is electronic polarizability?

8. Explain the significance of Curie temperature for a ferroelectric material.

9. What is Coherence length?

10. What is the importance of isotope effect in superconductivity?

Part B

Answer all questions choosing either (a) or (b) (5 x5 = 25)

11a. State the properties of reciprocal lattice. How is a reciprocal lattice constructed from a direct lattice?

(OR)

b. What are point group and space group? Explain the point groups of a two-dimensional lattice.

12a. Show that the velocity of a longitudinal wave in the [111] direction of a cube crystal is given by $v_s = [(C_{11} + 2C_{12}+4C_{44})/3\rho]^{\frac{1}{2}}$.

(OR)

b. Discuss the salient features of the dispersion relation for the vibrations of a one-dimensional mono-atomic chain.

13a. State and prove the Bloch theorem.

(OR)

b. Give the theory of Hall effect in semiconductor.

14a. Write a short note on ferroelectric crystals.

(OR)

b. Discuss Hund's rule.

15a. Give a brief account of ferromagnetic domains.

(OR)

b. Deduce London equations. How can London equations explain Meissner effect?

Part C

Answer any three questions **(3 x 10 = 30)**

16. Describe seven crystal systems with necessary diagrams.

17. With necessary derivations and diagrams, explain the analysis of stress components.

18. Discuss Kronig-Penney model. Explain the formation of allowed and forbidden energy bands on the basis of Kronig-Penney model.

19. Derive an equation for the internal field and hence the Clausius-Mossotti equation.

20. (a) How do entropy, specific heat and energy gap vary with temperature for superconductors.[6]

    (b) Explain the concept of BCS ground state. [4]

F–5407	Sub. Code
	7MPHE2B

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

Elective – MODERN OPTICS AND LASER PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. List out any four optical phenomena.
2. What is total internal reflection?
3. Define coherence time.
4. What is constructive and destructive interference?
5. Write down the condition for Fresnel and Fraunhofer diffraction.
6. How are holography used in interferometry?
7. In what way laser originates nonlinear optics?
8. Compare Laser Raman spectroscopy and conventional Raman spectroscopy.
9. Differentiate spontaneous and stimulated emission.
10. Point out the major applications of laser in electronics industry.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) State and explain Doppler effect.

Or

(b) Write a note on phase change in total internal reflection.

12. (a) Mention the significance of intensity interferometry.

Or

(b) How will you determine resolution of Fabry-Perot instruments?

13. (a) Elaborate Rayleigh-Sommerfeld formulation of diffraction.

Or

(b) Analyze the effects of film thickness in holography.

14. (a) With neat diagram, describe the first experimental evidence on existence of second harmonic generation.

Or

(b) Elucidate the concept of stimulated Raman scattering.

15. (a) Derive the relation between Einstein's coefficients that are used to explain the interaction of light with matter.

Or

(b) How are lasers used in communication?

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Elucidate Jones calculus of monochromatic light polarization.

17. Explain the background, function and nature of fringes of Michelson interferometer.

18. Give a detailed note on Kirchoff diffraction theory.

19. Arrive at an expression for nonlinear polarization and describe the significance of various order of polarization.

20. With aid of proper energy level diagram, explain the construction and functioning of He-Ne lasers.

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